INSTRUCTIONS

GEK-64454
Rev. A

SST/ECS TEST SET Cat. No. TAK-TS1

For Testing Types SST and ECS Solid-state Trip Devices Used on Types AK/AKR Low-voltage Power Circuit Breakers

MP MASTER
MA32651

GENERAL ELECTRIC

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INTRODUCTION

The SST/ECS Test Set is a portable instrument designed for field testing the performance of Types SST and ECS solid-state overcurrent trip devices employed on Type AK and AKR Low-voltage Power Circuit Breakers. The complete trip device system is comprised of the following components:

1. Solid-state Programmer Unit
2. Phase Current Sensors
3. Flux Shift Magnetic Trip Device
4. Fourth-wire Neutral Sensor for Type SST units containing a Ground Fault trip element for use on three-phase, four-wire load circuits.

All components, except the Neutral Sensor, are integrally mounted on the circuit breaker. When used, the Neutral Sensor is separately mounted in the bus or cable compartment of the switchgear. In drawout construction, it is automatically connected to the trip device on the breaker via a drawout secondary disconnect block.

The SST/ECS Test Set is used to perform the various trip device tests in two basic modes:

"A" – Solid State Programmer Unit Only
"B" – Complete Trip Device System

WARNING: *THESE TESTS CAN BE CONDUCTED ONLY ON A DEENERGIZED BREAKER - ONE WHICH IS COMPLETELY DISCONNECTED FROM ITS PRIMARY AND CONTROL POWER SOURCES.*

SOLID-STATE PROGRAMMER UNIT ONLY-MODE "A"

These tests are conducted with the programmer unit disconnected from the breaker. When performing the following tests, the programmer unit can remain mounted on the breaker, or can be completely removed from it.

Test Scope

1. Verify the time-current characteristics and pickup calibration of the various trip elements.

Designations for the trip elements are abbreviated as follows:

LT	-	Long Time
ST	-	Short Time
INST	-	Instantaneous
GF	-	Ground Fault

2. Verify operation of the SST target indicators on Programmer units so equipped.

COMPLETE TRIP DEVICE SYSTEM – MODE "B"

For these tests, the programmer unit must be mounted on the breaker and connected to its wiring harness.

Test Scope

1. All Programmer Unit tests previously described, plus the provision to optionally switch the Programmer's output to activate the Flux Shift Magnetic Trip Device to verify its operation via physically tripping the breaker.

2. Check continuity of the Phase Sensors.

SPECIFICATIONS

Input: 105-125 Vac 50/60 Hz
Power Consumption: 150 watts maximum
Weight: 20 pounds
Dimensions: 15 in. L x 9 in. H x 9 3/4 in. D

APPLICABLE TIME-CURRENT CURVES

ECS: LT, ST & INST ---------- GES-6032
SST: LT, ST & INST ---------- GES-6033
SST: Ground Fault ----------GES-6034, 6035

OPERATING CONTROLS

The SST/ECS Test Set indicators and operating controls are self identified on the front panel arrangement. (See Fig. 1).

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

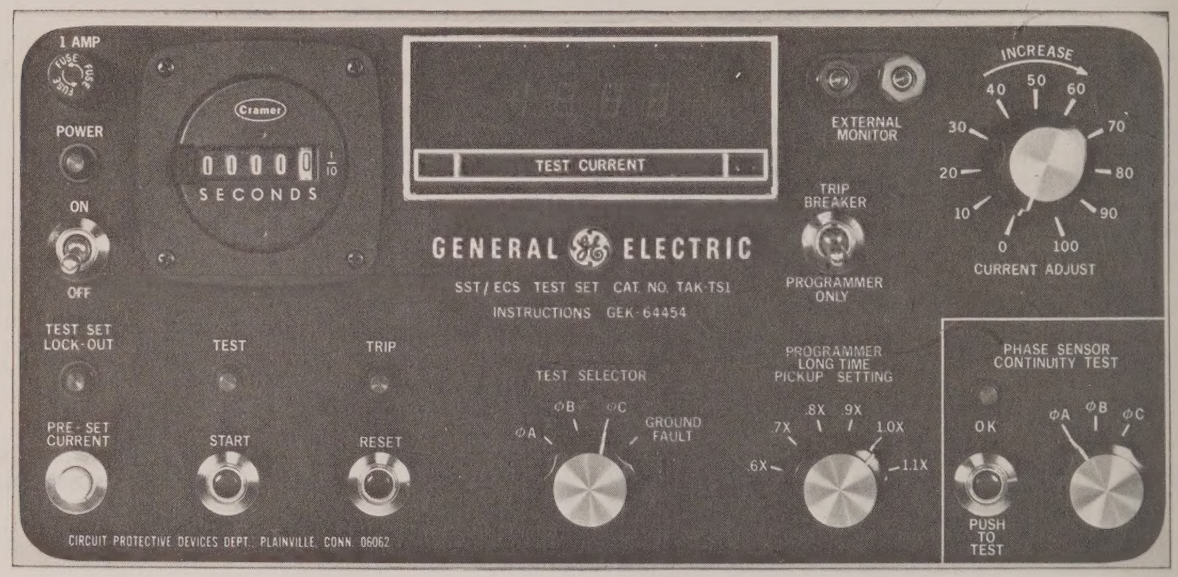


Fig. 1. Front panel

ON-OFF SWITCH

Applies 115 Vac input power to the test set. A red companion LED indicator, located directly above, illuminates when the switch is in the ON position. Protection is provided by a one ampere fuse, located above the indicator light.

TRIP BREAKER – PROGRAMMER ONLY SWITCH

Provides a choice of two test modes:

Programmer Only Position - Mode "A"

The programmer's trip signal output is confined to the test set circuitry and cannot trip the breaker.

Trip Breaker Position - Mode "B"

The programmer's trip signal output is directed to the circuit breaker's magnetic trip device to physically trip the breaker. This mode establishes the integrity of the magnetic trip device and the programmer's capability to actuate it.

TEST SELECTOR

Positioned according to the type of test desired – Phase Current A, B, C, or GROUND FAULT.

PROGRAMMER LONG TIME PICKUP SETTING SELECTOR

Establishes a test current magnitude consistent with, and specifically for, each LT pickup set point on the programmer. For all phase current testing (LT, ST and INST elements), the position of this control must match the LT pickup setting on the programmer.

CURRENT ADJUST KNOB

A variable transformer for establishing the desired level of test current to be applied to the programmer.

PRE-SET CURRENT BUTTON

Enables the operator to pre-establish (via the CURRENT ADJUST control) the desired test current prior to initiating a test. For this control to function, the programmer unit must be connected to the test set.

START BUTTON

Initiates the test run by applying current to the programmer. The current persists until the unit trips or the RESET button is actuated.

TEST INDICATOR

This LED lights whenever the PRE-SET CURRENT or START controls are activated.

TRIP INDICATOR

An LED which, when lit, indicates that an acceptable trip signal has been delivered by the pro-

grammer. Conversely, a trip not accompanied by the light signifies that the trip signal amplitude is too low. Upon completion of a test, the TRIP indicator stays lit until the RESET button is depressed.

RESET BUTTON

Resets the test set logic so that a new test sequence can be initiated. It also stops a test in progress.

PHASE SENSOR CONTINUITY TEST

This section of the panel contains controls for checking electrical continuity of each phase sensor circuit. The selector determines the phase to be tested. Proper continuity exists when the OK LED indicator lights up when the PUSH TO TEST button is depressed. No light signifies that a high resistance or open circuit exists in the CT or its wiring harness.

SIGNAL LEVEL METER

Provides digital readout of the test current level being applied to the programmer unit.

ELAPSED TIME METER

A mechanical counter which records the programmer's tripping time, in seconds and tenths. It must be manually reset after completion of each test.

NOTE: *When operating the test set from a 50 Hz supply, readings of the Elapsed Time Meter must be multiplied by a 1.2 factor.*

TEST SET LOCK-OUT INDICATOR

To prevent possible damage to the programmer unit when subjected to abnormally prolonged or continuous testing at high current levels, a lock-out circuit is provided. This circuit monitors the current-time input to the programmer such that when a predetermined limit is exceeded, the test set becomes inoperative for a period of approximately 70 seconds. It then automatically resets to its normal operating state. A lock-out condition exists whenever the TEST SET LOCK-OUT indicator is lit.

EXTERNAL MONITOR JACKS, TEST SET ACCURACY

The test current values displayed on the Signal Level Meter are accurate to within ± three percent of the meter reading. These limits are contingent upon a clean sine wave input voltage to the test set. Wave distortion can cause additional error.

Should greater accuracy be desired, provision is made for connecting external instruments via the EXTERNAL MONITOR jacks on the front panel. These jacks are connected across an isolated, precision 0.2 ohm resistor in series with the test current circuit. Output at these jacks is shown in Table 1.

The EXTERNAL MONITOR jacks may also be employed, in conjunction with a storage oscilloscope, for more accurate measurement of trip times. For trip times in the range of less than one second, the test set's time meter can provide only a single digit approximation (nearest 0.1 second).

TABLE 1
EXTERNAL MONITOR OUTPUT

TEST SET CONTROL POSITIONS		AC MILLIVOLTS PER L UNIT (± 1%)
TEST SELECTOR	PROGRAMMER LONG TIME PICKUP SETTING	
ØA, ØB or ØC	0.6X	60
	0.7X	70
	0.8X	80
	0.9X	90
	1.0X	100
	1.1X	110
GROUND FAULT	(Not Applicable)	AC Millivolts per X Unit (± 1%) 100

Example: Output @ 6L on LT Pickup test for 1.1 LT Pickup setting = 110 x 6 = 660 MV ± 1%

EXPLANATION OF "X" AND "L" CURRENT UNITS

On ECS and SST trip devices, circuit breaker currents are expressed in terms of "X" and "L" units. Adjustment set points on the programmer faceplate are calibrated and identified in these parameters.

"X" UNITS

By definition,

> X = TRIP DEVICE CONTINUOUS AMPERE RATING
>
> X = Current sensor or sensor tap rating

Each pole of an AK/AKR circuit breaker mounts a single current sensor.

On ECS trip devices, the sensors have no taps; therefore,

X = Sensor Ampere Rating

Example: For an ECS equipped with 1200 ampere sensors,

X = Sensor Rating = 1200 amp.

On SST trip devices, each sensor has four (4) taps, where

X = Amp. Rating of the tap in use

Example: An SST equipped with sensors whose range is 600 – 1600 amp. has taps at 600, 800, 1200 and 1600 amp. Assuming the 1200 tap is selected,

X = Sensor Tap Rating

= 1200 amp.

All AKR circuit breakers are furnished with an adjustable number wheel indicator mounted on the breaker front frame. Its function is to identify the particular ECS sensor rating or SST sensor tap in use. It displays X units directly and must be manually repositioned whenever a sensor rating (or sensor tap) is changed.

"L" UNITS

By definition,

> L = LONG TIME PICKUP Current in Amperes

On both ECS and SST programmer units, L is a function of X; by design, the LONG TIME PICKUP adjustment range is calibrated in six multiples of X, i.e.,

L = (0.6, 0.7, 0.8, 0.9, 1.0, or 1.1) X

Determination of L is a simple multiplication of two factors -- the programmer's LONG TIME PICKUP setting times the ECS sensor (or SST sensor tap) rating.

Example: Assume an SST trip device system set up as follows:

Sensor tap = 1200 amp., LONG TIME PICKUP set at 0.9X

Therefore,

X = Sensor Tap = 1200 amp.

L = (LT pickup setting) (sensor tap)

= 0.9X

= (0.9) (1200) = 1080 amp.

By design, the circuitry of the ECS/SST trip devices requires that the SHORT TIME and INSTANTANEOUS PICKUP values be expressed and calibrated in "L" units. Having established the ampere value of L (above), then the ST and INST PICKUP amperes at their particular settings (e.g., 10L) would be:

10L = Pickup value

10 X 1080 = 10, 800 amp

In contrast to the ST and INST elements, the SST GROUND FAULT element is independent of the LT circuitry. GROUND FAULT pickup values are not a function of the LONG TIME PICKUP setting and instead are expressed and calibrated in X units.

CONNECTING THE TEST SET

SAFETY PRECAUTIONS

WARNING: *BEFORE CONNECTING THE TEST SET TO THE BREAKER TRIP DEVICE SYSTEM, ENSURE THAT THE CIRCUIT BREAKER IS COMPLETELY DISCONNECTED FROM ITS POWER SOURCE. ON DRAWOUT EQUIPMENT, RACK THE BREAKER TO ITS DISCONNECTED POSITION. VERIFY THAT THE BREAKER IS TRIPPED.*

CAUTION: *NEVER DISENGAGE THE HARNESS CONNECTOR FROM THE PROGRAMMER UNIT ON A BREAKER THAT IS ENERGIZED AND CARRYING LOAD CURRENT. THIS WILL OPEN-CIRCUIT THE CURRENT SENSORS, ALLOWING DANGEROUS AND DAMAGING VOLTAGES TO DEVELOP. SEE FIG. 2.*

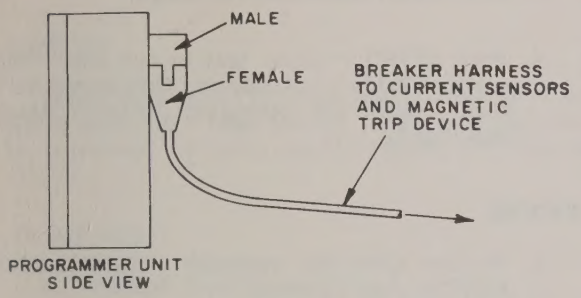


Fig. 2. Normal In Service breaker connection

CONNECTIONS

NOTE: *Before proceeding with the following connection work, ensure that the test set power supply cord is not connected.*

"Programmer Only" Test - Mode "A" (See Fig. 3)

1. Disconnect the breaker harness from the programmer unit.

2. Plug the test set female connector lead to the receptacle on the rear of of the programmer.

3. The test set male connector lead need not be connected to the breaker harness for "Programmer Only" testing. However, the Fig. 4 connection should be used if "Complete System" tests are to be run also.

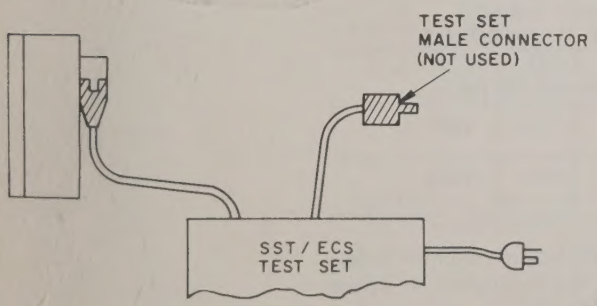


Fig. 3. Connection for Programmer Only test

"Complete System" Test - Mode "B" (See Fig. 4)

1. Disconnect the breaker harness from the programmer unit and reconnect its female connector to the male connector lead from the test set.

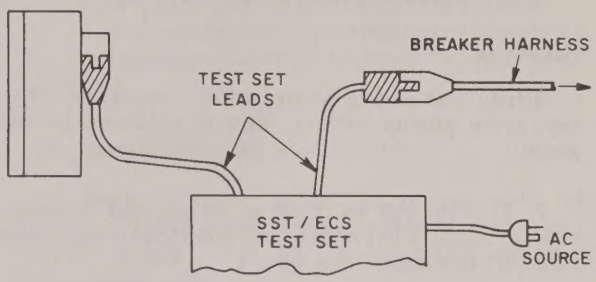


Fig. 4. Connection for Complete System test

2. Plug the test set female connector lead into the receptacle on the rear of the programmer.

PRELIMINARY TEST PROCEDURE

The following steps should be conducted before starting functional tests.

1. Position the test set controls as follows:

CURRENT ADJUST: rotate to zero
TEST SELECTOR: ØA
TRIP BREAKER - PROGRAMMER ONLY: As desired.
PROGRAMMER LONG-TIME PICKUP SETTING: Position this knob identical to the programmer's LT pickup setting.

2. Record the "In Service" settings of the programmer so that its set points can be restored upon completion of testing.

3. Connect the test set power cord to the 105-125 vac power source.

4. Turn power ON.

5. Push the START button. The elapsed time meter will start to run and the TEST indicator should light and remain lit.

6. Push the RESET button. The elapsed time meter will stop and the TEST indicator light will go out.

7. Mechanically reset the elapsed time meter. Functional testing, described individually for each trip element in subsequent pages, may now begin.

LONG TIME PICK UP TEST

PURPOSE

Verify that pickup occurs within tolerance. For any given pickup setting, this is achieved in two steps:

1. Test for NO PICKUP at 88 percent current, a value slightly below the published lower tolerance limit (91 percent). See Note 1.

2. Test for PICKUP at 118 percent current, a value slightly above the published upper tolerance limit (109 percent). See Note 2.

PROCEDURE

NO PICKUP

1. Programmer settings:

   LONG TIME DELAY – set on MIN band.

   The INT or MAX bands may be used if desired.

2. Position Test Set controls:

   PROGRAMMER LONG TIME PICKUP SETTING – Must match the programmer's LT pickup setting

   TEST SELECTOR - Ø A, B or C

   TEST CURRENT -- Preset at 0.88L

3. Reset timer and RESET button.

4. Push START – Allow test to run until time delay of Table 2 has expired. Unit should NOT trip. For 50 Hz operation, multiply timer readings by 1.2.

PICKUP

1. Position Test Set controls – Same as NO PICKUP, Step 2, except:

   Preset CURRENT LEVEL to 1.18L

2. Reset timer and RESET button.

3. Push START. Allow test to run until unit trips. The time meter reading should conform to Table 2 limits. For 50 Hz. operation, multiply timer readings by 1.2.

   If unit does not trip within the specified time, repeat the test, carefully monitoring and readjusting the test current as necessary. Transient dips in the supply voltage could lower the test signal current below its pickup value, causing the programmer's timing circuit to reset.

Repeat PICKUP and NO PICKUP tests on the other phases.

TABLE 2
LONG TIME PICKUP

MODE	TEST CURRENT L UNITS	TEST LIMITS TIME IN SECONDS MIN BAND	INT BAND	MAX BAND
NO TRIP	0.88	300	725	1650
TRIP	1.18	<200	<500	<1200

NOTES: 1. Lower test limits are extended below the published pickup tolerance to allow for test set accuracy.

2. Upper test limits exceed the published pickup tolerance to allow for test set accuracy plus nominal dips in test set supply voltage. During testing, the test current should be monitored and adjusted if necessary.

LONG TIME DELAY TEST

PURPOSE

Verify that the LT characteristic conforms to its upper and lower band limits. This test requires measurement of delay times at three different L values.

PROCEDURE

1. Position Test Set controls:

   PROGRAMMER LONG TIME PICKUP SETTING--Must match the programmer's LT pickup setting.

   TEST SELECTOR - Ø A, B, or C

   TEST CURRENT - From Table 3, select three L values to be tested. Preset the first value.

   NOTE: *These values must be below the short time and instantaneous pickup settings on the programmer, otherwise a premature trip signal will be received from those functions.*

2. Reset timer and RESET button.

3. Push START. Allow test to run until trip occurs. TIME meter reading should conform to Table 3 limits. For 50 Hz. operation, multiply timer readings by 1.2.

4. Repeat the above test at the other two L values. This step verifies the linearity of the T-C characteristic.

5. Repeat the test on the other phases at one L value.

Repeat the above test series on the other delay bands.

TABLE 3

LONG TIME DELAY

TEST CURRENT	TEST LIMITS* TIME IN SECONDS		
L UNITS	MIN BAND	INT BAND	MAX BAND
1.50	60.2-101.8	150.7-254.6	337.5-570.3
2.00	33.8-57.3	84.6-143.2	189.6-320.8
3.00	15.0-25.5	37.6-63.7	84.3-142.6
4.00	8.4-14.3	21.1-35.8	47.4-80.2
5.00	5.4-9.2	13.5-22.9	30.3-51.4
6.00	3.7-6.4	9.4-15.9	21.0-35.7
7.00	2.7-4.7	6.9-11.7	15.4-26.2
8.00	2.1-3.6	5.3-9.0	11.8-20.0
9.00	1.6-2.8	4.1-7.1	9.3-15.8
10.00	1.3-2.3	3.3-5.7	7.5-12.8

*Reflecting the test set accuracy, all test limits are proportionately extended beyond the published band limits of the time-current curves. The upper test limits correspond to 0.97L, the lower limits to 1.03L. During testing, the test current should be monitored and readjusted if necessary.

SHORT TIME PICKUP TEST

PURPOSE

Verify that pickup occurs within tolerance. This requires two tests at any desired pickup setting -- one for pickup at the upper tolerance limit, the second for no pickup at the lower tolerance limit.

PROCEDURE

PICKUP

1. Programmer settings:

   ST DELAY BAND - As desired.

   INST PICKUP – Must be set higher than the ST pickup setting, otherwise the unit will trip first on INST mode.

2. Position Test Set controls:

   PROGRAMMER LONG TIME PICKUP SETTING – Must match the programmer's LT pickup setting.

   TEST SELECTOR - Ø A, B, or C

   TEST CURRENT – Preset an Upper Limit L value from Table 4.

3. Reset timer and RESET button.

4. Push START. The unit must trip in less than one second, as indicated by the timer. For 50 Hz operation, multiply timer readings by 1.2.

ACTUAL PICKUP VALUE (if desired) -

Starting at the Lower tolerance limit (Table 4), test incremental increases in L until a trip occurs in less than one second, as indicated by the timer. Push the PRE-SET CURRENT button, read the actual pickup value.

NO PICKUP

1. Programmer settings – Same as PICKUP, Step 1.

2. Position Test Set controls – Same as PICKUP, Step 2 except:

   TEST CURRENT – Preset the lower limit L value from Table 4.

3. Push START. The unit must not trip in less than one second. However, a trip may occur after one second due to a signal from the LT element. For 50 Hz. operation, multiply timer readings by 1.2.

Repeat PICKUP and NO PICKUP tests for at least one setting on each of the other phases.

TABLE 4 — SHORT TIME PICKUP

PROGRAMMER ST PICKUP SETTING *	TEST CURRENT			
	60 Hz		50 Hz	
	LOWER LIMIT (NO PICKUP)	UPPER LIMIT (PICKUP)	LOWER LIMIT (NO PICKUP)	UPPER LIMIT (PICKUP)
1.75L	1.53	1.98	1.48	1.93
2L	1.75	2.27	1.69	2.20
2.25L	1.96	2.55	1.91	2.48
2.5L	2.18	2.83	2.11	2.75
3L	2.61	3.40	2.54	3.30
4L	3.49	4.54	3.39	4.40
5L	4.36	5.67	4.24	5.50
6L	5.23	6.80	5.08	6.59
8L	6.98	9.07	6.78	8.79
10L	8.73	11.33	8.47	10.99

*L = Long Time pickup setting

SHORT TIME DELAY TEST

PURPOSE

Provide an approximate indication that time delay occurs within the time band selected. Due to the small time magnitudes involved (0.5 seconds or less), the timer's right digit provides only a rough approximation of the actual trip time. If a more accurate reading is desired, the EXTERNAL MONITOR jacks may be employed as described previously in OPERATING CONTROLS.

PROCEDURE

1. Programmer settings:

   INST PICKUP - set at maximum (12L).

2. Position Test Set controls:

   PROGRAMMER LONG TIME PICKUP SETTING – Must match the programmer's LT pickup setting.

   TEST SELECTOR – Ø A, B or C

   TEST CURRENT – Preset an L value two steps higher than the programmer's ST pickup setting (e.g., preset 10L for an 8L pickup setting). This avoids measurement at the knee of the time – current curve, where the time delay may be longer than the band limits given in Table 5.

3. Reset timer and RESET button.

4. Push START. Observe trip time.

Repeat the above test on the other time bands, then check at least one band on each of the other phases.

TABLE 5
SHORT TIME DELAY

BAND	PUBLISHED BAND LIMITS- TIME IN SECONDS	
	LOWER	UPPER
MIN	0.095	0.19
INT	0.21	0.32
MAX	0.35	0.50

INSTANTANEOUS PICKUP TEST

PURPOSE

Verify that pickup occurs within tolerance. This requires two tests at a given pickup setting – one for pickup at the upper tolerance limit, the second for no pickup at the lower tolerance limit.

PROCEDURE

PICKUP

1. Position Test Set controls:

   PROGRAMMER LONG TIME PICKUP SETTING – Must match the programmer's LT pickup setting.

   TEST SELECTOR – ØA, B, or C

   TEST CURRENT – Preset an Upper Limit L value from Table 6.

2. Reset timer and RESET button.

3. Push START. The unit must trip immediately as indicated by little or no discernible timer movement.

ACTUAL PICKUP VALUE (if desired) -

Starting at the lower tolerance limit (Table 6), test incremental increases in L until an INST trip occurs (no discernible timer movement). Push the PRESET CURRENT button, read the actual pickup value.

NO PICKUP

1. Position Test Set controls – Same as PICKUP, Step 1, except:

   TEST CURRENT – Preset the Lower Limit L value from Table 6.

2. Push START. The unit must not trip instantaneously (as in PICKUP, Step 3) - the INST element is not activated at these lower limit L values. However, the unit is subject to and will respond to a time delayed trip signal from the LT element. Also, if so equipped, it responds to any ST element whose pickup is set below the INST setting. In either event, the delayed trip produces definite movement of the timer, a positive indication that the unit did not trip via the INST mode.

Repeat PICKUP and NO PICKUP tests for at least one setting on each of the other phases.

TABLE 6

INSTANTANEOUS PICKUP

PROGRAMMER PICKUP SETTING	TEST CURRENT IN L UNITS			
	60 Hz		50 Hz	
	LOWER LIMIT @0.873L (NO TRIP)	UPPER LIMIT @1.133L (TRIP)	LOWER LIMIT @0.847L (NO TRIP)	UPPER LIMIT @1.099L (TRIP)
4L	3.49	4.54	3.39	4.40
5L	4.36	5.67	4.24	5.50
6L	5.23	6.80	5.08	6.59
8L	6.98	9.07	6.78	8.79
10L	8.73	11.33	8.47	10.99
12L	10.47	13.60	10.16	13.19

SST GROUND FAULT PICKUP TEST

PURPOSE

Verify that pickup occurs within tolerance. Two tests are required at a given pickup setting – one for pickup at the upper tolerance limit, the second for no pickup at the lower tolerance limit.

PROCEDURE

PICKUP

1. Position Test Set controls:

   TEST SELECTOR – GROUND FAULT

   TEST CURRENT – Preset an Upper Limit X value from Table 7.

   NOTE *For ground fault testing, the digital meter displays X units.*

2. Reset timer and RESET button.

3. Push START. The unit must trip, timer will indicate less than one second. For 50 Hz operation, multiply timer readings by 1.2.

ACTUAL PICKUP VALUE (if desired) -

Starting at the Lower Limit (Table 7), test incremental increases in X until a trip occurs in less than one second, as indicated by the timer. Push the PRESET CURRENT button, read the actual pickup value.

NO PICKUP

1. Position Test Set Controls – Same as PICKUP, Step 1 except:

   TEST CURRENT – Preset the Lower Limit X value from Table 7.

2. Reset timer and RESET button.

3. Push START. The unit should not trip, timer will read greater than one second delay. Discontinue the test after one second. If the test is allowed to run longer than 30 seconds, a trip signal can be received from the LT element for some programmer setting combinations. For 50 Hz operation, multiply timer readings by 1.2.

TABLE 7 — GROUND FAULT PICKUP

PROGRAMMER GF PICKUP SETTING *	TEST CURRENT			
	60 Hz		50 Hz	
	LOWER LIMIT (NO PICKUP)	UPPER LIMIT (PICKUP)	LOWER LIMIT (NO PICKUP)	UPPER LIMIT (PICKUP)
0.18X 0.2X	0.157 0.174	0.204 0.227	0.152 0.169	0.198 0.220
0.22X 0.25X	0.192 0.218	0.249 0.283	0.186 0.212	0.242 0.275
0.27X 0.3X	0.235 0.260	0.306 0.340	0.229 0.254	0.297 0.330
0.35X 0.37X 0.4X	0.305 0.323 0.348	0.397 0.419 0.453	0.296 0.313 0.339	0.385 0.406 0.440
0.5X 0.6X	0.436 0.523	0.567 0.680	0.424 0.508	0.550 0.659
0.7X 0.8X	0.611 0.698	0.793 0.906	0.593 0.678	0.769 0.879
1.0X 1.2X	0.873 1.047	1.133 1.360	0.847 1.016	1.099 1.318

*X = Sensor ampere rating or tap setting

SST GROUND FAULT TIME DELAY TEST

PURPOSE

Provide an approximate indication that time delay occurs within the time band selected. Due to the small time magnitudes involved (0.5 seconds or less), the timer's right digit provides only a rough approximation of the actual trip time. If a more accurate reading is desired, the EXTERNAL MONITOR jacks may be employed as described previously in OPERATING CONTROLS.

PROCEDURE

1. Position Test Set controls:

   TEST SELECTOR – Ground Fault

   TEST CURRENT – Preset a value of 2X. This ensures that the test current is well above the knee of the curve for all GROUND FAULT pickup settings.

NOTE *For ground fault testing, the digital meter displays X values.*

2. Reset timer and RESET button.

3. Push START. Observe trip time.

Repeat test on the other time bands.

PHASE SENSOR CONTINUITY TEST

PURPOSE

Check continuity of the breaker-mounted phase sensors.

NOTE 1. The test set does not measure accuracy of the phase sensors. This can be established only by testing the complete trip device as a system, in conjunction with the breaker, using a commercially available high current – low-voltage test set.

NOTE 2. The test set is not for use in testing the equipment-mounted neutral sensor employed with SST trip devices equipped with a ground fault trip element for three-phase, four-wire applications. This neutral sensor is excluded from the scope of the circuit breaker/trip device test procedures, and instead should be treated as an integral part of the maintenance and testing activity associated with the switchgear equipment.

PROCEDURE

1. Ensure all power is removed from the circuit breaker and that the male connector from the test set is connected to the female connector of the circuit breaker harness.

2. Select the phase to be tested.

3. Push the PUSH-TO-TEST button. The OK light must light while the PUSH-TO-TEST button is depressed. Absence of the OK light indicates a high resistance or open circuit in the CT or wiring harness.

TABLE 8

GROUND FAULT TIME DELAY

BAND	PUBLISHED BAND LIMITS TIME IN SECONDS	
	Lower	Upper
MIN.	0.065	0.15
INT	0.165	0.27
MAX	0.30	0.43

FAULT TRIP INDICATORS

As an optional accessory, ECS and SST programmer units may be equipped with pop-out type fault trip indicators located along the top of the face plate. These are associated with their particular trip elements as indicated in Table 9.

In operation, these plungers pop out each time their respective trip element delivers a trip signal. If a programmer trips on LT overload, only the "OVERLOAD" indicator is activated. For short circuits other than ground faults, the "SHORT CIRCUIT" indicator serves both the ST and INST elements and is activated by either. The "GROUND" indicator (SST only) responds only to a ground fault trip.

When testing programmers so equipped, the trip plungers are functioning properly if they are activated each time their respective trip element trips.

IF TEST RESULTS DO NOT CONFORM

- Review the instructions to see that the proper test procedure is being followed.
- Check all settings on the programmer unit.
- Is the TEST SELECTOR switch in the GROUND FAULT position for ground fault testing? In the ØA, ØB or ØC position for all other tests?
- Does the PROGRAMMER LONG-TIME PICK-UP SETTING control on the test set match the programmer's LT pickup setting?
- Is the TRIP BREAKER – PROGRAMMER ONLY switch in the proper mode?
- Are all cable connectors fully engaged?
- If the ST element trips too soon or at too low a level, the INST pickup setting is probably too low. The INST pickup must be set at a higher L value than the ST element.
- Timer makes noise but does not operate. Push RESET button. Manually reset timer.
- When using 50 Hz power, the timer reading must be multiplied by 1.2.
- See Section OPERATING CONTROLS regarding test set accuracy.
- Use the EXTERNAL MONITOR jacks as described in OPERATING CONTROLS to check the current level that is being applied to the programmer unit. These jacks may be used also to monitor trip time.
- If, after repeating the test(s), results do not conform, do not reconnect the circuit breaker until the defective component is replaced.

COMPLETION OF TESTS

After the trip device testing has been completed, diligent procedures must be exercised preparatory to restoring the circuit breaker to service:

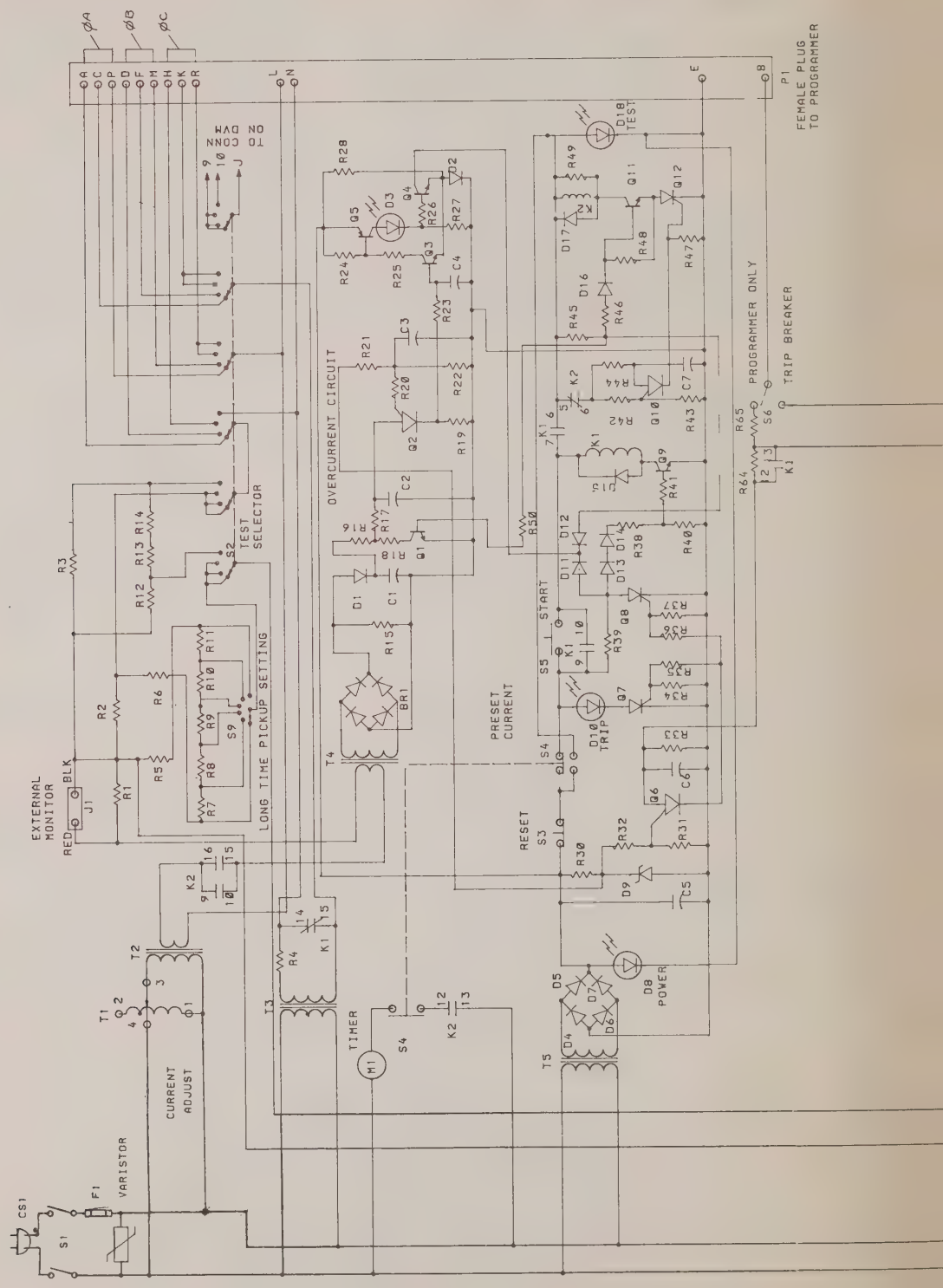
- Ensure that the breaker is fully disconnected from any power source.
- Disengage the test set connectors from the programmer and the female circuit-breaker harness connector.
- Reconnect the female harness connector to the programmer unit. Failure to do this voids the breaker's automatic trip system.
- Reset all target annunciators on the programmer.
- If the programmer's adjustment knobs were moved to different settings during testing, restore them to their original, "as received" settings.

Table 9

TRIP INDICATORS

FAULT INDICATOR	TRIP ELEMENT	COLOR CODE ON SST
Overload	LT	Yellow
Short Circuit	ST & INST	Red
Ground*	GF*	Green

*Available on SST only.


ØA
ØB
ØC
TO CONN DYM
FEMALE PLUG TO PROGRAMMER
PROGRAMMER ONLY
TRIP BREAKER
OVERCURRENT CIRCUIT
TEST SELECTOR
LONG TIME PICKUP SETTING
EXTERNAL MONITOR
CURRENT ADJUST
VARISTOR
TIMER
PRESET CURRENT
START
RESET
D18 TEST
D10 TRIP
D8 POWER

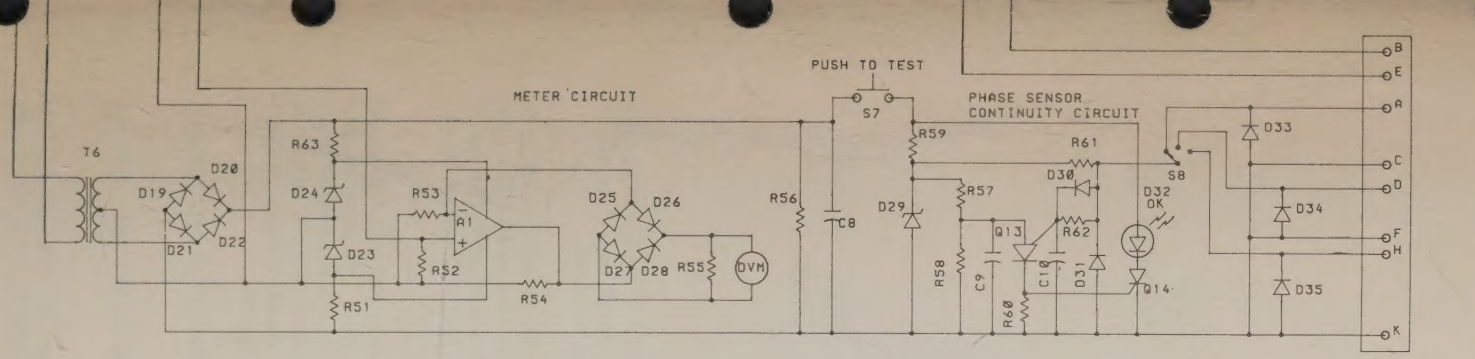


Fig. 5. Schematic Diagram – SST/ECS Test Set, Cat. No. TAK-TS1 (Drawing No. 139C4370)

PARTS LIST FOR FIG. 5

RESISTORS	DESCRIPTION (Ohms)
R1	0.2 ± 0.1% - 25W
R2	0.5 ± 1% - 50W
R3	10.0 ± 1% - 25W
R4	3000 ± 5% - 10W
R5, R12, R13, R58	1K ± 1% - 1/4W
R6	909 ± 1% - 1/4W
R7	261 ± 1% - 1/4W
R8	196 ± 1% - 1/4W
R9	154 ± 1% - 1/4W
R10	121 ± 1% - 1/4W
R11	100 ± 1% - 1/4W
R14	2.8K ± 1% - 1/4W
R15	806 ± 1% - 1/2W
R16, R17, R18, R32	100K ± 1% - 1/4W
R19, R20, R44, R52, R62	1 MEG ± 10% - 1/4W
R21	332K ± 1% - 1/4W
R22	681K ± 1% - 1/4W
R23, R24, R28	51K ± 5% - 1/4W
R25	22K ± 5% - 1/4W
R26, R34, R37, R40, R48, R60	1K ± 5% - 1/4W
R27	220 ± 5% - 1/4W
R30, R39, R45	2.2K ± 5% - 1/2W
R31	34K ± 1% - 1/4W
R33	1.0 ± 1% - 3W
R35, R36, R41	2.2K ± 5% - 1/4W
R38, R46	4.7K ± 5% - 1/4W

RESISTORS (Cont'd)	DESCRIPTION (Ohms)
R42, R43	10K ± 5% - 1/4W
R47	270 ± 5% - 1/4W
R49	2.7K ± 5% - 1/2W
R51, R63	1K ± 5% - 1/2W
R53	1406 ± 0.1% - 1/8W
R54, R50	100K ± 5% - 1/4W
R55	1500 ± 0.1% - 1/8W
R56	100K ± 10% - 1/2W
R57	3.65K ± 1% - 1/4W
R59	100 ± 5% - 2W
R61	390 ± 5% - 2W
R64	560 ± 5% - 1/2W
R65	68 ± 5% - 1/2W

CAPACITORS	DESCRIPTION (Mfd.)
C1	1.0 ± 10% - 250 VDC
C2	270 ± 10% - 15 VDC (Tantalum)
C3, C4, C6, C9, C10	0.1 ± 10% - 100 VDC
C5, C8	150 - 75 VDC (Aluminum)
C7	0.33 ± 10% - 50 VDC

DIODES	DESCRIPTION
BR1	Varo VE18
D1, D2, D11, D12, D13, D14, D16, D25, D26, D27, D28, D30	IN4148

DIODES (Cont'd)	DESCRIPTION
D4, D5, D6, D7, D15, D17, D19, D20, D21, D22, D31, D33, D34, D35	IN5060
D3, D8, D10, D18, D32	LED - 28V - 20 ma
D9	15 V ± 1% - 1W
D23, D24	IN4740 - 10V - 1W
D29	IN5352B - 15V - 5W

TRANSISTORS AND SCRS	DESCRIPTION
Q1, Q3, Q4, Q9, Q11	GET 930
Q2, Q6, Q10, Q13	2N6028
Q5	2N5087
Q7, Q8, Q12, Q14	C103B
A1	OP. Amp. MC1741CP

TRANSFORMERS	DESCRIPTION
T1	Variable Transformer GE 9T92A1
T2	Stancor P8641
T3	Triad N-48X

TRANSFORMERS (Cont'd)	DESCRIPTION
T4	GE 567B743G4
T5, T6	Stancor P8601

SWITCHES	DESCRIPTION
S1	JBT ST22K
S2	Centralab SA2021-4C-000
S3	Grayhill 4002
S4	Grayhill 46-05-08-502-0101
S5, S7	Grayhill 4001
S6	JBT ST12D
S8, S9	Centralab SA2001-4C-000

RELAYS	DESCRIPTION
K1, K2	Allied T154-4C-28 VDC

CONNECTORS	DESCRIPTION
P1	Amp 201298-1
P2	Amp 201297-1

VARISTOR	V150LA20A
TIMER	Cramer 636S10084
EXTERNAL MONITOR JACK	H.H. Smith 269RB
DVM	Digitec 2770-02

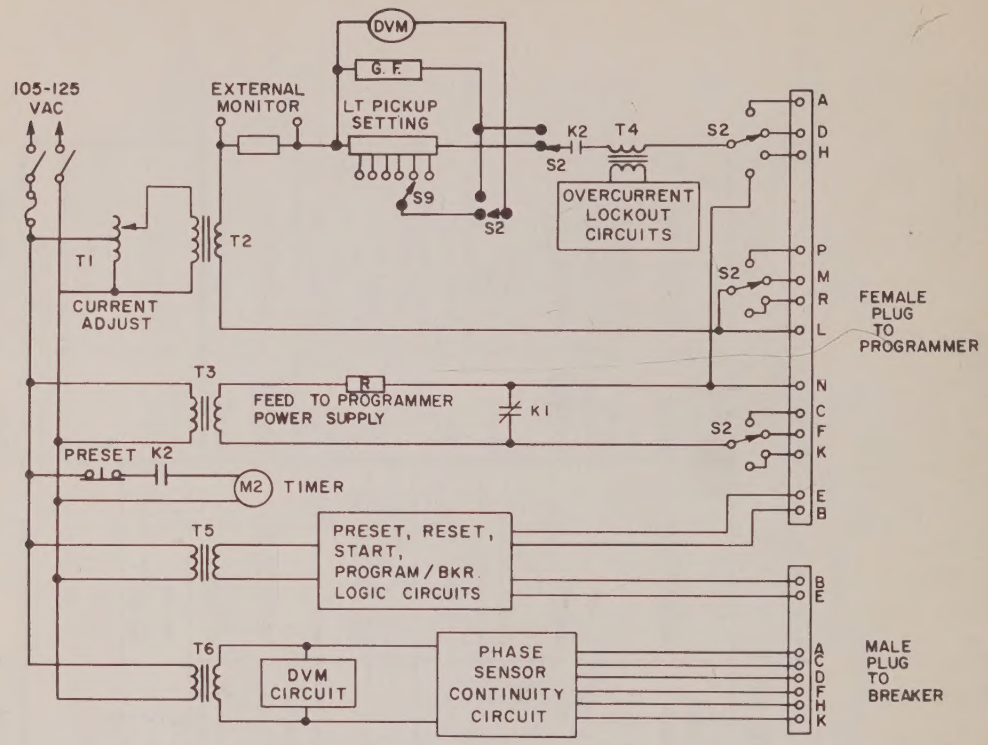


Fig. 6. Test set simplified schematic

CIRCUIT DESCRIPTION

A brief description of the test set circuitry is given below. Refer to the simplified schematic of Figure 6.

1. Input voltage is applied to the test set through a three-wire power cord with a ground conductor. The chassis and metal parts are grounded to protect the operator.

2. Output voltages are isolated from the input voltage by means of multiple winding iron core transformers.

3. All power to the test set is supplied through the ON-OFF switch and a one ampere slo-blo fuse.

4. T2 is a 12.6 volt filament transformer that provides the low-voltage simulated fault signal currents to the programmer via the TEST SELECTOR switch S2 when relay contact K2 is closed. The test current is adjusted by variable transformer T1.

Switches S2 and S9 provide the appropriate resistor selection for the digital meter.

The EXTERNAL MONITOR is a precision shunt resistor which provides an output that is an accurate representation of the test current.

5. The overcurrent lock-out circuit protects the programmer from prolonged or continuous testing at high current levels. Once energized, the circuit will lock out the test set for approximately 70 seconds and then automatically reset.

6. T3 is an isolation transformer that feeds the power supply of the programmer. Power is transferred when relay K1 is energized (normally closed contact opens). K1 is energized slightly before K2 in order to ensure that power supply voltage is available before test current is applied.

7. Power is applied to the timer by relay contact K2.

8. Transformer T5 powers the test set logic circuitry.

9. Transformer T6 powers the PHASE SENSOR CONTINUITY TEST circuit and the drive circuitry for the digital voltmeter.

For complete schematic diagram see Fig. 5.

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